CASE REPORT – OPEN ACCESS

International Journal of Surgery Case Reports 3 (2012) 222–226

Contents lists available at SciVerse ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.elsevier.com/locate/ijscr

Spectrum of all-terrain vehicle injuries in adults: A case series and review of the literature

Elizabeth Concannon[b,*], Aisling Hogan[b], Aoife Lowery[b], Ronan S. Ryan[a], Waqar Khan[b], Kevin Barry[b]

[a] Department of Surgery, Mayo General Hospital, Castlebar, Co. Mayo, Ireland
[b] Department of Radiology, Mayo General Hospital, Castlebar, Co. Mayo, Ireland

ARTICLE INFO

Article history:
Received 5 October 2011
Received in revised form 17 January 2012
Accepted 29 January 2012
Available online 19 February 2012

Keywords:
ATV
All-terrain vehicle
Quad bike
Off road motor vehicle
Prevention of ATV injury
Adult trauma

ABSTRACT

INTRODUCTION: Serious injury secondary to all terrain vehicle usage has been widely reported since the 1970s. All-terrain vehicles (ATV) or 'quad bikes' are four wheeled vehicles used for agricultural work, recreation and adventure sport. Data collected in the U.S. indicates that ATV related injury and fatality is increasing annually.
PRESENTATION OF CASES: This case series describes 3 cases of significant ATV related trauma in adults presenting to one regional hospital in the West of Ireland over a 12 month period.
DISCUSSION: Epidemiology, mechanisms of injury, spectrum of injury in adults and preventative measures to reduce the number of ATV related injuries and fatalities are discussed here with a review of the literature.
CONCLUSION: A paucity of research outside of North America is highlighted by this case series. Mandatory reporting of ATV related injury, educational, training and legislative measures are suggested as injury prevention strategies.

1. Introduction

All-terrain vehicles (ATVs) are four wheeled vehicles which travel on low pressure tyres with engine sizes varying from 49 to 1000 cc. ATVs have an inherently unstable design with a narrow-wheel base, short turning radius, high centre of gravity and low tyre pressure to maximize manoeuverability. They travel at speeds of up to 120 km per hour or more depending on engine size and vehicle design. Injury and fatalities secondary to ATV use have been documented worldwide since their invention in Japan in the 1960s and subsequent introduction to the U.S. in the 1970s. They are in popular use in agricultural work due to their ability to handle a variety of terrain, light footprint and speed. ATVs have also gained popularity in competition racing, off road travel and recreation. They are classified in Ireland as 'off road vehicles' and legislation regarding appropriate driving licensing, insurance, vehicle standards regulations and concomitant use of a helmet/safety belt only applies to the use of these vehicles on public roads.[1]

2. Presentation of cases

Each of the cases, outlined in Table 1, describes off road ATV use. Two cases involved recreational use and one case illustrated agricultural operation. There was no use of helmets, safety belts or other protective equipment in any of the cases described and none of these patients had received training in the use of ATVs. The patient in each case was the sole driver and occupant of the ATV. One case resulted in fatality and the other two cases required emergency surgery with satisfactory post-operative recovery.

3. Discussion

3.1. Rate of injury

The rate of injury sustained specifically from ATV use is unknown in Ireland as annual figures compiled by the National Road Safety Authority group these injuries under the broader category of 'motor cycle injuries'. A number of studies from the US and Canada demonstrate a gradual rise in the rates of ATV related injuries and deaths in recent years.[2–4]

3.2. Epidemiology

In each case described in this series, the injured party was the driver of the vehicle. 80–90% of injuries involve the driver of the ATV as opposed to a passenger.[3,5,6] Risk factors for ATV related injury and death include male sex, age <18, white race, rural residence, intoxication, driving inexperience, recreational use of ATV as opposed to work related usage and large engine size.[7] Large engine ATV production has increased threefold since 2003.[8] These large engine vehicles can reach speeds of up to 120 km per hour and may weigh in excess of 230 kg.[9] One case control study[10] estimated a

* Corresponding author. Tel.: +00353 91 523890.
E-mail address: lizconcannon@gmail.com (E. Concannon).

2210-2612 © 2012 Surgical Associates Ltd. Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.ijscr.2012.01.012

Table 1

.

	Case 1	Case 2	Case 3
Mechanism of injury	25 year old female Fall from ATV, driving on beach No helmet/safety belt Flexion–distraction of head from neck/torso witnessed by physician at scene	22 year old male Fall from ATV, thrown 3 m landing on left side No helmet/safety belt Loss of consciousness × 2 mins and amnesia for event with persistent headache	37 year old male farmer Crushed between ATV and wall for 5 min after losing control of ATV while driving inside a shed No helmet/safety belt Severe left upper quadrant pain with nausea and vomiting
Vitals on arrival	Guedel airway in situ Agonal asynchronous breaths BP: unrecordable HR: pulseless ECG: pulseless electrical activity Sp02: unrecordable Temp: 34.5 °C GCS: 3/15 Pupils: fixed and unreactive	Airway intact breathing uncompromised BP:152/70 HR: 62 Sp02: 97% room air Respiratory rate: 15/min GCS: 15/15	Airway intact Breathing uncompromised BP: 131/69 HR: 80 Sp02: 96% room air Respiratory rate: 22/min GCS: 15/15
Initial assessment & management	CPR continued on arrival Fluid resuscitation with crystalloids and O negative packed red blood cells Sinus tachycardia and BP 170/90 in response to CPR Chest drain inserted for clinical left pneumothorax Active blood loss from scalp laceration, epistaxis, haemoptysis and abdomen distended	Superficial haematoma and swelling at left temporal region + haemotympanum Left clavicle tenderness Abdomen soft non tender with superficial abrasions Onset of vomiting with GCS drop to 13/15, 12 h after initial injury	Abdomen soft with left upper quadrant tenderness without guarding/rigidity/rebound Patient remained stable with conservative medical management for 24 h but self discharged against medical advice He represented 5 days after his accident with worsening abdominal pain at which point he had developed hypovolemic shock and localised peritonism in the left upper quadrant. Hb dropped to 6.6 from 13.4 g/dL in the interim
Imaging	*CT Brain* (Fig. 1) Gross brain oedema with coning *CT Spine* (Fig. 2) Grossly displaced, distracted C2 fracture *CT thorax/abdomen/pelvis* (Fig. 3) Bilateral pneumothoraces, multiple left sided rib and clavicle fracture. Small bowel, mesenteric and hepatic lacerations	*CT Brain* (Fig. 4) Extradural haematoma left temporo-parietal area with brain oedema and 5 mm midline shift to right and undisplaced temporal fracture *Chest/left shoulder X-ray* Left clavicle fracture with inferior displacement of proximal fragment	*USS abdomen – initial presentation* 5 cm diameter haematoma in the interpolar region of the spleen with crescentric fluid collection around the spleen. Normal renal and hepatic outlines and no free abdominal fluid *CT abdomen – 5 days later* (Fig. 5) Splenic rupture with a large intra and perisplenic haematoma and significant volume haemoperitoneum.
Operative intervention	Nil	Transferred to neurosurgical facility for *left craniotomy with extradural haematoma evacuation*	*Laparotomy with splenectomy* – severely lacerated spleen within a large haematoma and blood in abdominal cavity+++
Outcome	Transferred to intensive care unit post CT imaging transfused total of 6 units of packed red blood cells 2nd cardiac arrest (pulseless electrical activity) and cushing response. RIP 2 h post admission	Uneventful post op recovery Mild memory and concentration impairment with emotional liability on follow up cognitive assessment	24 h ICU admission post op transfused total of 4 units of packed red blood cells Uneventful post op course Appropriate vaccination and antimicrobial prophylaxis initiated

0.9% increase in risk of ATV injury/death for every 1% increase in engine size. Paediatric injury and fatality from ATV use has been well described in the literature[4,11] although they account for just 15% of ATV users.[4] The average age of ATV related mortality is 28 years.[9]

3.3. Comparison with motorcycle trauma

Two retrospective studies comparing motorcycle trauma with ATV trauma have shown similar mortality and ATV riders were found to be significantly younger and more severely injured (as per comparison using the median injury severity score) with a higher incidence of head and neck injury (56% vs. 30%, $p < 0.001$).[12]

A recent study[13] compared the risk of injury and death from ATV use to that of off road motorcycles or 'dirt bikes'. The study involved more than 50,000 cases and showed both groups had similar injury severity scores. However unadjusted mortality was higher for ATV users (2.6% vs. 1.2%) and remained 1.51 fold higher after adjustment for factors such as gender, age, injury severity score, GCS and helmet use. Off road motorcycle users also had lower rates of ICU admission and ventilation compared with ATV users.

3.4. Mechanism of injury

The mechanisms of injury involved in our case series included fall from the ATV (Cases 1 and 2) and crush injury (Case 3). There are three main mechanisms of injury in ATV accidents as described